

EARSeL

ADVANCES IN REMOTE SENSING

Microwave Remote Sensing of Sea Ice

Vol. 3, No. 2, December 1994

Editor-in-Chief
EARSeL Publications

Dr. Robin Vaughan

A.P.E.M.E.
University of Dundee
Dundee DD1 4HN
Scotland, U.K.

Guest Editor

Prof. Jan Askne

Dept. of Radio and Space Science
Chalmers University of Technology
S-412 96 Göteborg
Sweden

Editorial Assistant

Madeleine Godefroy

EARSeL Secretariat
Bureau 418
2, avenue Rapp
F-75340 Paris Cedex 07
France

INSTRUCTIONS FOR PAPERS TO BE INCLUDED IN THE EARSEL INTERNATIONAL JOURNAL “ADVANCES IN REMOTE SENSING”

Papers presented at EARSeL Workshops are printed, after reviewing, in the EARSeL International Journal “Advances in Remote Sensing”.

Conditions and instructions to be followed by authors are the following:

- papers must be submitted in their final form at the Workshop registration desk;
- the reviewers comments will be sent to the authors within two months after the meeting ;
- after receiving the reviewers' recommendations, authors are requested to send their final papers on diskette using: MS-DOS operating system (Word processor: Wordstar; Word; Chiwrite, etc.); (Desk Top Publisher: Ventura);

If not submitted at the Workshop registration desk, papers should be mailed to

Ms. Fiona Wallace
A.P.E.M.E.
University of Dundee
Dundee DD1 4HN, Scotland, UK
Fax: +44 382 202830

- Each paper must be accompanied by a 100 to 200 word abstract, written as a single paragraph. It should be a summary and complete in itself. The abstract should indicate the subjects dealt with in the paper and should state the objectives of the investigations.

The text should contain:

(a) Introduction, (b) Main text with sections and subsections numbered, (c) Conclusions, (d) Acknowledgements, (e) Appendices, (f) References, (g) Tables, (h) Illustrations.

- The title should be brief and concise. The author's name should be typed on the line below the title, and it is preferable to use the full name. The company affiliation should follow on the next line, with the author's official title and complete mailing address.

- Equations and symbols should be typewritten. Symbols that are not available on the typewrite may be hand written, but clarity is essential.

- Illustrations (diagrams, drawings and photographs) should be in black and white, or in colour if strictly necessary. Photographs should be glossy prints. Each figure must have a caption; captions should be listed on a separate sheet. Illustrations numbered in a single sequence from 1 upwards and with the author's name on the back of each illustration. Each figure should be cited in numerical order in the text.

- Each table must be on a separate sheet accompanied by a caption.

- References should be cited in the text thus: (Smith, 1975); and listed in alphabetical order in the reference section.

The following arrangements should be used:

Journals: BENNY, A.H., 1980, Coastal definition using Landsat data. Int. J. Remote Sensing, 1, 225.

Books: JACQUES, E., 1976, A General Theory of Electromagnetics (London: Heinemann)

Reports: HARNAGE, J., and LANDSEER, D. (editors, 1975, Landsat-D) thematic mapper technical working group. Final Report, JSC-099797, Johnson Space Center, Huston, Texas.

EARSel ADVANCES IN REMOTE SENSING

Volume 3 Number 2 December 1994

FOREWORD

<i>J. Askne</i>	VII
-----------------------	-----

PAPERS

ERS-1 SAR backscatter from nilas and young ice during freeze-up <i>L. Ulander, A. Carlström and J. Askne</i>	1
Modelling radar sea ice backscatter in support of the ERS-1 SAR <i>K.C. Partington and M. Hanna</i>	9
Radar backscatter estimates from a combined ice growth and surface scattering model of first year sea ice <i>R.H. Wade and W.F. Weeks</i>	24
Interpretation of radar signatures observed in SAR images of ice island T-3 by means of backscatter modelling <i>W. Dierking, C. Garrity and R.O. Ramseier</i>	31
Accuracy of ice concentration derived from ERS-1 SAR images during the late melt period in the Arctic <i>J. Askne, L.M.H. Ulander, and D. Birkeland</i>	44
SizeX'92 ERS-1 SAR ice validation experiment <i>S. Sandven, O.M. Johannessen, K. Kloster and M. Miles</i>	50
A new correlation technique for ice-motion analysis <i>Y. Sun</i>	57
ERS-1 SAR over water in the Baltic sea <i>A. Herlevi and Matti Leppäranta</i>	64
Microwave signatures of sea ice from ARKTIS'93 experiment <i>K. Flückinger, G. Gmünder and Ch. Maetzler</i>	71
Merging microwave radiometer data and meteorological data for improved sea ice concentrations <i>L.T. Pedersen</i>	81
Wind events compared with polynya area estimates derived from SSM/I data <i>T. Markus and B.A. Burns</i>	90
Arctic sea-ice during the winter to summer transition as seen by the AMI-wind and ATSR/M of ERS-1 <i>R. Ezraty, F. Gohin and A. Cavanié</i>	100
Sea ice extent mapping using the ERS-1 radar altimeter <i>S. Laxon</i>	112

FOREWORD

This issue of *Advances in Remote Sensing* reflects the outcome of the first specialist workshop on remote sensing of sea ice in Europe. It was attended by 45 participants who made it a worthwhile and interesting event. It was hosted by the Electromagnetics Institute of the Technical University of Denmark in Lyngby and co-chaired by Prof. Preben Gudmandsen of this Institute and Prof. Jan Askne of the Department of Radio and Space Science at Chalmers University in Göteborg, Sweden.

Selected from the 28 presentations thirteen papers are included in this issue of *Advances in Remote Sensing*. As will appear, all papers are based on data from microwave sensors, illustrating the increasing interest in studying and using data from microwave sensors rather than visual and infrared sensors for sea ice observations and monitoring. The launch of ERS-1 has of course increased the interest, in particular for SAR data, but also for the other sensors onboard that satellite.

A number of papers illustrated trends in the development of remote sensing techniques for the interpretation of signatures of sea ice at various stages. Fundamental work is carried out to understand backscattering or emission processes by modelling and field measurements. Such work is of importance for accurate sea ice classification, for instance, but also for understanding ice formation and melt observations. Field measurements are crucial in this context, often carried out with great difficulty due to the extreme weather conditions prevailing. Large signature variations have been observed, probably due to changing weather conditions leading to uncertainties in interpretation of remote sensing data. Attempts are made to use fine-resolution data at metre scale from aircraft and satellite – SAR and visual data – to “calibrate” other remote sensing data at much coarser scale such as SSM/I data, with the usual difficulty of scaling the observations. A major application of SAR data is the derivation of ice motion under the influence of wind and ocean currents where sea ice is used as a “tracer” reflecting geophysical phenomena.

Although sea ice algorithms seem to behave properly under many conditions, winter conditions in particular, the large signature variations cause problems in segmentation and ice classification. Examples of temporal and spatial variations on scales from local to regional and from days to season seem to be a way of overcoming the problem as illustrated in some of the papers. The combination of data from different sensors seems to be another way of approach. With the variability of sea ice signatures due to meteorological variations it is natural to combine remote sensing data with meteorological and climatological data, and an example of this was given in the workshop. It also included an example of the value of combining remote sensing observations with geophysical modelling.

The workshop provided a spectrum of different approaches to the use of remote sensing data in studies and monitoring of sea ice. It demonstrated that although much progress has been made, there is still a great deal of work to be carried out before the techniques may be used safely operationally and in climate change research. It served as a forum for the exchange of ideas and contact between scientists in Europe and overseas and it is recommended that more initiatives of this kind are considered.

Jan Askne
Göteborg